Statistics And Probability
Assignment

Q1) The maximum weight that an elevator in an apartment complex can accomodate is 800 kg. The average adult weight be about 70 kgs with a variance of 200. What is the probability that the lift safely reaches the ground when there are 10 adults in the lift.

A:-

Given:- Mean = 70 kgs.
Variance = 200.

Sol: Mean for 10 adults = $10(70) = 700$.
Variance for 10 adults = $10(200) = 2000$.
Standard deviation = $\sqrt{\text{Variance}}$ =
$\sqrt{2000} = 44.72$.

When $w > 800$kg : unsafe for the elevator to reach the ground
∴ Calculating the upper tail of our normal distribution,
: $P(w > 800)$.
i.e : P(Weight of 10 adults > 800 kg)

$$Z\text{-Score} = \frac{(X - M)}{S.D}$$

$$= \frac{800 - 700}{44.72} = 2.24.$$

Hence $P(z < 2.24)$, By using the Z-table,
we get 0.9875 (i.e) 98.75 %.

This tells us that, the lift is safely reaches the ground with 10 adults.

Q2) The life of a 60-watt light bulb in hours is known to be normally distributed with $\sigma = 25$ hours. Create 5 different samples of 100 bulbs each which has a mean life of x_bar ~ 1000 hours and perform one way ANOVA with state it.

Given:- $n = 100$

$\bar{x} \sim 1000$.

Solution:- i) Sample is been generated.

ii) Analysis of variance (i.e) ANOVA should be applied for the sample generated data.

Steps:- Once the ANOVA is applied and obtained, we get 2 tables Summary and ANOVA.

There are 5 sample sets with each having 100 values

$\therefore$ Sample 1 $= n_1 = 100$

Sample 2 $= n_2 = 100$

Sample 3 $= n_3 = 100$

Sample 4 $= n_4 = 100$

Sample 5 $= n_5 = 100$.

$N = (n_1 + n_2 + n_3 + n_4 + n_5)$ = Total Samples

$\therefore N = 500$.

$\alpha = 0.05$ (Given)

$k = 5$ (No of groups)

→ For each of the samples, mean is been calculated with sum and count.

$\bar{x}_g$ → Mean of each group $= \frac{\Sigma x_g}{n}$

$= 1001, 1003, 1003, 999, 1000$ respectively.

→ Variance for each of the group is also calculated.

$$s^2 = \frac{\Sigma (x_g - \bar{x})^2}{n-1}$$

→ Overall sample mean $= \bar{\bar{x}} = \frac{\Sigma \bar{x}_g}{N} = 1001.2$.

→ Variance for each group:
662,591, 643, 768, 577 respectively.

→ Calculating the degree of freedom which is mandatory.

$df_1 = K-1 = 5-1 = 4$

$df_2 = N-k = 500-5 = 495$

$df = (k-1)+(N-k) = 499$.

Hypothesis testing:-

i) Null hypothesis = $H_0 = H_1 = H_2 = H_3 = H_4 = H_5$

ii) Alternate hypothesis = H_1 = Not all the means are equal.

ANOVA → Obtaining the calculated values from ANOVA,

→ Sum of squares is calculated.

i) SS_W → Sum of squares within groups

$= \Sigma\Sigma (x-\bar{x}_g)^2 = 320870.$

ii) SS_B → Sum of squares between the groups

$= \Sigma n_g (\bar{x}_g - \bar{x})^2$

$= 946.$

iii) SS_T → Sum of squares total

$= \Sigma\Sigma(x-\bar{x})^2$

$= 321816.$

→ Calculating the mean sum of squares (between and within)

i) $MS_B = \frac{SS_B}{df_1} = \frac{946}{4} = 236.5 = 237$

ii) $MS_W = \frac{SS_W}{df_2} = \frac{320870}{495} = 648.22 = 648$

→ Test statistic is calculated.

$$F_{stat} = \frac{MS_B}{MS_W} \rightarrow \text{Ratio of mean squares.}$$

$$= \frac{237}{648} = 0.3648.$$

→ Calculating F_{crit} → F critical.

$$F_{crit} = \frac{df_1}{df_2} = \frac{4}{495} = 2.3719 \quad (\because \text{Obtained from the table})$$

Conclusion:-

i) From the above obtained,

$F_{crit} > F_{stat}$

∴ We can conclude that the alternative hypothesis is rejected.

Also from ANOVA,

ii) P-value is been calculated,

$P = 0.83367$, where $P > 0.05$,

∴ We reject the alternative hypothesis.

3) Solution:- The given table is copied into excel. ANOVA is been applied.

Given:- The total scores and average are already been given.

→ Mean for all the three samples are obtained.

$\bar{X}_1 = 80$, $\bar{X}_2 = 85$, $\bar{X}_3 = 75$.

→ Variance for all the three samples are obtained.

$\sigma_1^2 = 38.5$ $\sigma_2^2 = 35$ $\sigma_3^2 = 38.5$

Confidence interval → 95%.

Significance level → 5%.

Hypothesis testing: $H_0 = H_1 = H_2 = H_3$

H_1 = Means are not equal.

From Anova:

$SS_B = 250$, $SS_W = 448$.

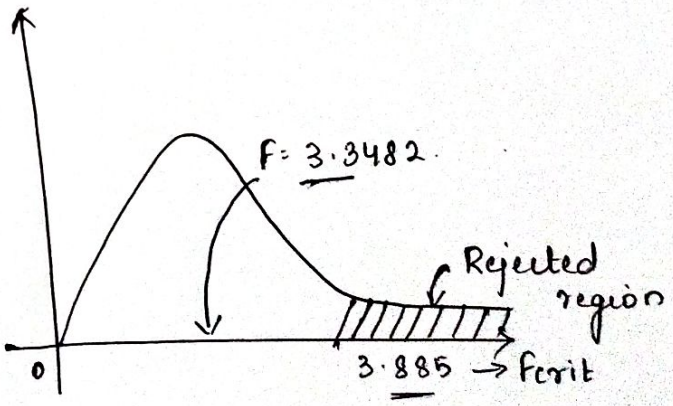
$MS_B = 125$, $MS_W = 37.33$

$df_1 = 2$ $df_2 = 448$.

$F = 3.3482$.

P-value $= 0.069909$.

$F_{crit} = 3.885294$.



Conclusion:-

The F statistics will be on the left part of the F_{crit} value. Therefore it is not present in the rejected region.

∴ Alternate hypothesis is rejected.

And null hypothesis is accepted.